

# **STUDY GUIDE**

## **DISTRIBUTION**

### **SUBCLASS D**

WISCONSIN DEPARTMENT OF NATURAL RESOURCES  
BUREAU OF INTEGRATED SCIENCE SERVICES  
P. O. BOX 7921  
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## **PREFACE**

This operator's study guide represents the results of an ambitious project. Operators of water supply facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for the Water Supply Distribution Certification Exam.

The objectives in this study guide have been organized into four modules: (A) Principle, Structure and Function; (B) Operation and Maintenance; (C) Monitoring and Troubleshooting; and, (D) Safety And Calculations. The objectives are organized to correspond to the major concepts in each module.

This study guide was revised in 2006 to include new objectives relating to the EPA Disinfectants and Disinfection Byproducts (D/DBP) Rule. Objectives that were newly developed or revised to cover the D/DBP Rule are preceded by "\*\*\*NEW\*\*\*". Exam questions have been written to correspond to the concepts included in this study guide.

### **HOW TO USE THESE OBJECTIVES WITH REFERENCES**

In preparation for the Water Supply Distribution Exam, the operator should:

1. Read all the objectives and write down the answers to the objectives that readily come to mind.
2. Use the resources at the end of the objectives to look-up those answers you are not sure of.
3. Write down the answers found in the resources to those objectives you could not answer from memory.
4. Review all answered objectives until you can answer each from memory.

**IT IS ADVISABLE THAT THE OPERATOR ATTEND SOME FORM OF FORMAL TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.**

### **Choosing A Test Date**

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates can be found in the annual DNR "Certified Operator," in the DNR's Operator Certification & Licensing Training Calendar on the DNR Web Site (<http://www.dnr.state.wi.us/org/es/science/opcert/training.htm>) or by contacting your DNR District operator certification coordinator.

## DISTRIBUTION

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### MODULE A: PRINCIPLE, STRUCTURE AND FUNCTION

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#### CONCEPT: PRINCIPLES OF DISTRIBUTION

1. Describe the major components of a distribution system.
2. Discuss the reasons for metering water.
3. Define coliform and pathogenic bacteria.
4. State the water quality significance of the following:
  - A. pH.
  - B. Oxygen.
  - C. Manganese.
  - D. Iron.
  - E. Hardness.
  - F. Alkalinity.
  - G. Iron Bacteria.
  - \*\*NEW\*\*
  - H. Natural Organic Matter (NOM)

#### CONCEPT: STRUCTURE AND FUNCTION

5. Define the following storage facilities:
  - A. Stand Pipes.
  - B. Reservoirs.
  - C. Elevated Tanks.
6. Describe the functions that elevated water storage serves in a distribution system.
7. Discuss the properties of the following types of pipe:
  - A. Ductile Iron.
  - B. Cast Iron.
  - C. Asbestos cement.
  - D. Plastic (PVC).
  - E. Steel.
  - F. Reinforced Concrete.
8. Identify the different types of valves used in a distribution system.

9. Describe the operation and use of a gate valve.
10. Describe the operation and use of a butterfly valve.
11. Identify the different types of pumps used in a distribution system.
12. Describe the function of the following parts of a centrifugal pump:
  - A. Impeller.
  - B. Shaft.
  - C. Sleeves.
  - D. Bearings.
  - E. Lantern Ring.
  - F. Mechanical Seal.
  - G. Pump Casing.
  - H. Packing.
  - I. Packing Gland.
  - J. Volute.
13. Given a diagram of a centrifugal pump, label the parts.
14. Describe how a centrifugal pump works.
15. List and describe the function of the basic elements of a fire hydrant.
16. Given a sketch of a typical service from the main to a customer's meter, label the parts.
17. List the types of meters used in a distribution system.
18. Given a diagram of a positive displacement meter, label the parts.
19. Identify locations where thrust blocks and tie rods should be used.

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**MODULE B: OPERATION AND MAINTENANCE**

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**CONCEPT: OPERATION**

20. List the pressure standards for:
  - A. Minimum Fire Flow Pressure.
  - B. Minimum Static.
  - C. Maximum Static.
  
21. Explain the accepted water main installation procedures with respect to the following:
  - A. Unloading Pipe.
  - B. Storage Of Pipe.
  - C. Trenching.
  - D. Bedding.
  - E. Pipe Laying.
  - F. Backfilling.
  - G. Clean up.
  
22. Describe the procedures necessary before a new main is placed in service.
  
23. Describe the locations or angles recommended for tapping water mains.
  
24. List the procedural steps involved in tapping a water main under pressure using a tapping machine.
  
25. Explain why water mains are tapped under pressure.
  
26. Discuss the methods used to locate valves and mains.
  
27. Explain the use and importance of records in locating valves or mains.
  
28. Explain how to determine if a valve is open or closed.
  
29. Explain what happens if a valve is closed too fast.
  
30. Explain the difference between dry and wet barrel hydrants.

31. Discuss the accuracy and common usage of the following meters:
- A. Positive Displacement.
  - B. Compound.
  - C. Turbine.
32. Discuss the factors which must be considered in selecting the correct meter size.
33. Discuss electrical continuity in relation to plastic water meters and the removal of a water meter (plastic or metal) from its setting.
34. Define the following terms:
- A. Cross-connection.
  - B. Backflow.
  - C. Back-siphonage.
  - D. Backpressure.
35. Describe the following ways of controlling cross-connections, and explain how each works and is applied.
- A. Air Gap.
  - B. Reduced Pressure Principal Backflow Preventer.
  - C. Double Check Valve.
  - D. Vacuum Breaker.
  - E. Barometric Loop.

**CONCEPT: MAINTENANCE**

36. Describe the items of information to be recorded on a meter test card.
37. List the items of information to be recorded on a valve record card.
38. Discuss how often valves and hydrants should be operated.
39. List good operational and maintenance procedures in relation to:
- A. Pump Priming.
  - B. Pump Packing.
  - C. Pump Bearings.
  - D. Pump Alignment.

40. State how often cross-connection control devices need to be inspected or tested.
41. Describe two ways steel storage tanks can be protected from corrosion.
42. Identify two qualities required of paint that will be in contact with potable water.

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**MODULE C: MONITORING AND TROUBLESHOOTING**

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**CONCEPT: MONITORING**

43. Given examples of different types of meter registers, demonstrate ability to correctly read the meters.
44. Explain what is involved in a meter test bench operation.
45. Describe the maximum contaminant level (MCL) for coliform bacteria.
46. State how the minimum number of routine monthly bacteriological samples for community water supply systems is determined.
47. Describe a good bacteriological sampling program.
48. Explain the ideal sampling point for bacteriological sampling sites.
49. List the types of faucets or taps from which bacteriological samples should not be collected.
50. Describe sample container requirements used in collecting bacteriological samples from the following:
  - A. Chlorinated Distribution Systems.
  - B. Non-chlorinated Distribution Systems.
51. State the holding time for bacteriological samples.
52. Identify a method of storing bacteriological samples that cannot be analyzed immediately.

53. Identify the laboratories in Wisconsin where bacteriological samples may be analyzed.
54. Describe the procedure to follow when a bacteriological sample is deemed "unsafe".
55. State how many bacteriological samples must be collected after a reservoir has been cleaned or repaired, before it is put back into service.
56. Identify the laboratory tests where DPD and SPADNS chemicals are used:
57. Identify the range in which fluoride should be maintained.
58. Identify the maximum contaminant level (MCL) for fluoride.
59. State how often samples must be sent to the State Laboratory of Hygiene for fluoride analysis.
60. Specify how often an operator must test for fluoride if fluoride is being added to the water.
61. Identify the sample container requirements used in collecting fluoride samples.
62. Describe the fluoride test procedure utilizing the SPADNS method.
63. Identify the free chlorine residual that must be maintained throughout the distribution system if a facility is required to chlorinate.
64. State how often an operator must test the chlorine residual in a distribution system if chlorine is being added.
65. Describe the free chlorine test procedure utilizing the DPD Method.
66. **\*\*NEW\*\*** Explain the term maximum residual disinfectant level (MRDL) and list the MRDL for chlorine, chloramines and ozone.
67. Explain the correct way to read a water level meniscus in a piece of volumetric laboratory glassware.



- 68. Describe how to run a pH test using a pH meter.
- 69. Discuss the various methods used to determine the stability of water with respect to calcium carbonate saturation.
- 70. Describe the calculations involved in using the Langelier Index and the Calcium Carbonate Solubility Curve in determining corrosive or depositing properties of a particular water.
- 71. **\*\*NEW\*\*** Identify where samples are collected for trihalomethanes (TTHMs) and haloacetic acids (HAA5s) analysis and list the MCLs.

**CONCEPT: TROUBLESHOOTING**

- 72. Determine the cause and solution for the following water quality problems:
  - A. Rusty Water.
  - B. Slime In Water Mains.
  - C. Unsafe Samples.
  - D. Stale Tasting Water.
  - E. Rotten Egg Odor.
- 73. Identify possible causes for the following pipe problems:
  - A. Joint Leaks.
  - B. Blow Outs.
  - C. Horizontal Cracks.
- 74. Identify methods of leak detection.
- 75. Discuss how a main break can be isolated on a distribution system so the fewest possible customers are affected.
- 76. Identify ways to stop water flow in a copper service so a leaking curb stop can be fixed.
- 77. List the possible causes for the following pump problems:
  - A. Short Bearing Life.
  - B. Cavitation.
  - C. Short Packing Life.
  - D. Vibration.
  - E. Loss of Prime.
  - F. Reduced Rate of Discharge.
  - G. Will Not Start.

78. Describe the symptoms of cavitation and old packing in pumps.
79. Identify the conditions that can cause back siphonage and backpressure.
80. Describe problems and remedies for low and high water pressure.
81. Identify possible causes and solutions for loss of system pressure.
82. Describe the procedures to be followed when distribution system pressure is lost in 23% or more of the system.
83. Explain the need and methods of maintaining electrical continuity when thawing frozen metallic pipe.
84. Explain how to thaw nonmetallic services.
85. Explain how to thaw metallic water services.

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#### MODULE D: SAFETY AND CALCULATIONS

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##### CONCEPT: SAFETY

86. Describe the procedure to follow for safe trench shoring.
87. Identify which State Agency has a code on safe trenching practices.

##### CONCEPT: CALCULATIONS

88. Convert the following: GPM figures to MGD, cubic feet to gallons, and gallons to cubic feet.
89. Given data, calculate the pounds of chlorine needed to disinfect a reservoir or section of pipe.
90. Given the height of water in a elevated storage tank, calculate the static pressure.
91. Given data, calculate an arithmetic average.

## DISTRIBUTION RESOURCES

1. SMALL WATER SYSTEM OPERATION AND MAINTENANCE. 1st Edition (1990). Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.
2. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER. 17th Edition (1989), 18th Edition (1992). Joint Publication of: American Public Health Association; American Water Works Association; and, Water Environment Federation (Old WPCF). Publication Office: American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.
3. WATER DISTRIBUTION SYSTEM OPERATION AND MAINTENANCE. 2<sup>nd</sup> Edition (1989). Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142
4. WISCONSIN ADMINISTRATIVE CODE NR 809 SAFE DRINKING WATER. Wisconsin Revisor of Statutes Bureau.
5. WISCONSIN ADMINISTRATIVE CODE NR 811 REQUIREMENTS FOR THE OPERATION AND DESIGN OF COMMUNITY WATER SYSTEMS. Wisconsin Revisor of Statutes Bureau.

Wisconsin Administrative Codes are available electronically at <http://www.legis.state.wi.us/rsb/code.htm>. To purchase printed code books contact the Wisconsin Department of Administration, Document Sales and Distribution Section at 608-266-3358.

6. **\*\*NEW\*\*** Complying With the Stage 1 Disinfectants and Disinfection Byproducts Rule: Basic Guide. US EPA (March 2006) EPA No. 816-B-05-004.

Supplement A to the above publication covers water systems that use chlorine dioxide or ozone as a disinfectant. US EPA (March 2006) EPA No. 816-B-05-005.

Supplement B to the above publication covers water systems that utilize a surface water source. US EPA (March 2006) EPA No. 816-B-05-006.

EPA publications can be downloaded from EPA's Safe Drinking Water Web site at [www.epa.gov/safewater](http://www.epa.gov/safewater) (search by publication number). You can also call the Safe Drinking Water Hotline at 1-800-426-4791 to request the documents.

**THE FOLLOWING ADDITIONAL RESOURCES CAN BE OBTAINED FROM:**

AMERICAN WATER WORKS ASSOCIATION  
MEMBER SERVICE DEPARTMENT  
6666 W. QUINCY AVENUE  
DENVER, CO 80235  
(303) 794-7711  
1-800-92-ORDER

(THE TOLL FREE NUMBER IS FOR CHARGE CARD CUSTOMERS OR AWWA MEMBERS)

7. BASIC MANAGEMENT PRINCIPLES FOR SMALL WATER SYSTEMS. AWWA No. 20222 (1982).
8. CORROSION CONTROL FOR OPERATORS. AWWA No. 20232 (1986).
9. CROSS-CONNECTION AND BACKFLOW PREVENTION. Gustave J. Angele. AWWA No. 20106 (1974).
10. DISTRIBUTION SYSTEM MAINTENANCE TECHNIQUES. AWWA No. 20237 (1987).
11. LEAKS IN WATER DISTRIBUTION SYSTEMS. AWWA No. 20236 (1987).
12. MAINTAINING DISTRIBUTION-SYSTEM WATER QUALITY. AWWA No. 20231 (1985).
13. MAINTENANCE MANAGEMENT. James K. Jordan. AWWA No. 20252 (1990).
14. PLAIN TALK ABOUT DRINKING WATER. James M. Symons. AWWA No. 70076 (1991).
15. PUBLIC INFORMATION - HOW TO BUILD A SUCCESSFUL PUBLIC INFORMATION/PUBLIC RELATIONS PROGRAM. AWWA No. 20242 (1989).
16. WATER CONSERVATION. William O. Maddaus. AWWA No. 20238 (1987).

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